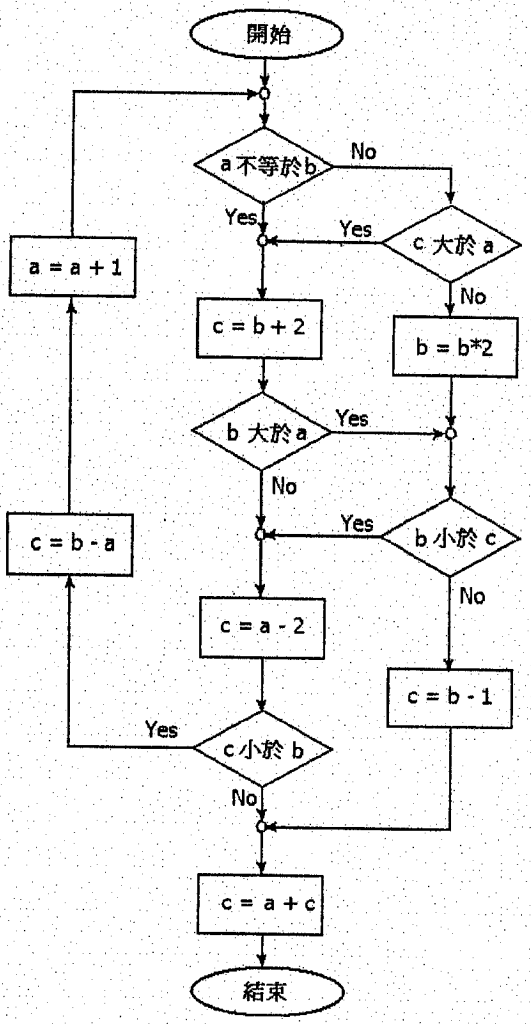
系所別: 機械工程學系　己組　科目: 基礎科目

1. (20 分) 一程式之流程圖如下圖所示，
   (a) 若在開始時 a = 3, b = 5, c = 1,請問到結束時 a, b, c 值為何?
   (b) 若在開始時 a = 5, b = 4, c = 9,請問到結束時 a, b, c 值為何?
   (c) 若在開始時 a = 2, b = 2, c= -5,請問到結束時 a, b, c 值為何?
   (d) 請問是否會有無限迴圈的情況存在，請舉個例子說明。



參考用

2. (20 分) 請用你最熟悉的程式語言，寫一程式找出從 1 到 1000 之間的質數個數及其總合。

注意：背面有試題

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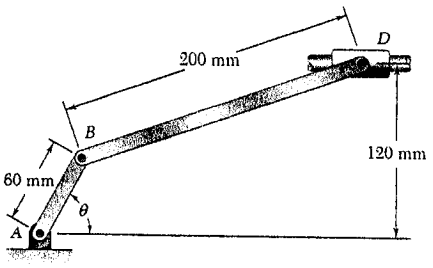
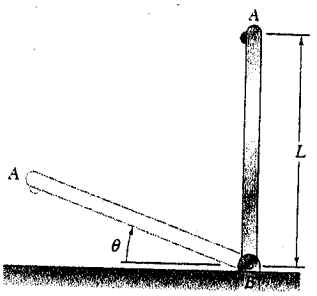
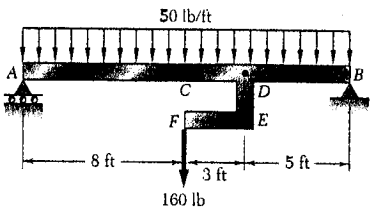
3. Knowing that crank *AB* has a constant angular velocity of 160 r/min counterclockwise, determine the angular velocity of rod *BD* and the velocity of collar *D* when (*a*) θ=0, (b) θ=90°. (20 分)



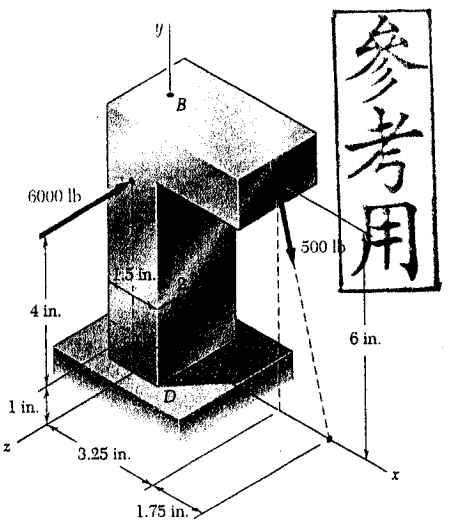
4. The uniform slender rod *AB* is in equilibrium in the position shown when end *A* is given a slight nudge, causing the rod to rotate counterclockwise and hit the horizontal surface. Knowing that the coefficient of restitution between the knob at *A* and the horizontal surface is 0.40, determine the maximum angle of rebound θ of the rod. (20 分)



5. The rigid bar *DEF* is welded at point *D* to the steel beam *AB*. For the loading shown, determine (a) the equations defining the shear and bending moment at any point of the beam, (b) the location and magnitude of the largest bending moment. (20 分)



6. Two forces are applied to the small post *BD* as shown. Knowing that the vertical portion of the post has a cross section of 1.5×2.4 in., determine the principal stresses and principal planes at point *H*. (20 分)



參考用

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7. Describe the definition of the following terms:
   (a) saturation pressure (b) heat (c) thermal efficiency　(10 分)

8. Starting with the second *Tds* relation, show that for an ideal gas undergoing an isentropic process, the temperature and pressure obey the following relation, if the specific heats are approximately constant.　(10 分)

$$TP^{\frac{k}{k-1}} = \text{constant}$$

9. Air enters a compressor at 100 kPa and 300 K and is compressed to 150 kPa.
   (a) Assume that air can be treated as an ideal gas and the process is isentropic. What is the exit temperature of the air? What is the required work input per kg of the air? ($k = 1.4$, $c_p = 1.004 kJ/kg \cdot K$)　(10 分)
   (b) The compressor efficiency is 70%. Answer the questions listed in (a).　(10 分)

10. Fluid flows over a flat plate with a laminar boundary layer formed in which the streamwise velocity can be approximated by

$$\frac{u}{U} = a\left(\frac{\delta}{y}\right) + b + c\left(\frac{y}{\delta}\right)$$

where a, b, c are constants, U the free stream velocity, δ the boundary layer thickness and y the vertical distance from the plate. Assume the flow is two dimensional, incompressible and no pressure gradient in the streamwise direction.
   (a) List appropriate boundary conditions to obtain a, b, and c.　(6 分)
   (b) Consider a streamline entering the boundary layer 1cm above the plate. Evaluate the displacement thickness.　(5 分)
   (c) How far from the plate will the streamline be at the leading edge of the plate? How far from the plate will the streamline be at the location where δ=0.5 cm and δ=1.5 cm respectively?　(9 分)

11. A nozzle with exit area A_2 is mounted at the end of a pipe of area A_1. The nozzle converges gradually. We assume the flow is (i) steady, (ii) uniform over any cross section area, (iii) incompressible and (iv) inviscid. The gravitational effects are also negligible. The volume flow rate in the nozzle is given as Q and the ambient pressure is p_a.
   (a) Derive an expression for the gage pressure in the nozzle at a station where the area is $A(x)$.　(5 分)
   (b) Show that the net axis-component force acted on the nozzle's wall by the pressure is independent of the specific nozzle contour and is given by
   $F = \rho Q^2 (A_1 - A_2)^2 / 2A_1 A_2^2$　(10 分)
   (c) The expression in (b) predicts that F is pointing to the nozzle exit regardless of whether $A_1 > A_2$ or $A_1 < A_2$. Explain.　(5 分)